REMARKS

The foregoing amendments are responsive to the March 26, 2007 Office Action. Applicant respectfully request reconsideration of the present application in view of the foregoing amendments and the following remarks.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Response to Rejection of Claims 1-24 Under 35 U.S.C. 101

The Examiner rejected Claims 1-24 under 35 U.S.C. 101 because the inventions as disclosed in claims are directed to non-statutory subject matter.

All of the claims recite a result that is useful, concrete, and tangible. Methods that produce results stored in a computer are statutory and patentable if they meet the other requirements for patentability. (*See, e.g.*, State Street Bank, 149 F.3d 1368 (Fed. Clr. 1998.) Furthermore, all of the claims involve a structural relationship between compression and more efficient processing (See, e.g. Lowry, 32 USPQ2d 1031 (Fed. Cir. 1994).

As an example of such structural relationships, Claims 2 and 9 involve matrices having elements that are equal to or may be approximated by zero. The patent application states (On the bottom of Page 17 and onto Page 18 or in paragraph [0163] of the published application), "It is usually desirable to perform computations so that sparse storage is used and so that the number of internal computations is minimized so that these computations execute quickly on computers." The following paragraph in the application describes an efficient embodiment where the processing is made efficient by storing both a matrix $A_{i,j}$ and a matrix $A_{i,j}\sim$, but the total storage is reduced by deleting $A_{i,j}$ after a certain amount of processing is accomplished and retaining $A_{i,j}\sim$. The application states (On Page 38 or in Paragraph [0164] of the Published Application), "When moving on to succeeding rows, $A_{i,j}$ will not be retained, but the other quantities are retained". Notice that this embodiment has specific features that make it efficient on existing computers. A feature of all claims of the present invention that is structurally related to its use on existing computers is that many embodiments have the ability to use BLAS subroutines to execute instructions at a rapid rate.

Claims 2-8, 15, 16 and 25 recite specific tangible results. They recite the transformation of a description of interactions due to electric charges into a description of certain multiple interactions involving electric charges. Furthermore, they recite a method that provides a decomposition having zero values. This results in a structural relationship among the method used, how the computation is performed and how it is stored on a computing system.

Claim 25, which is dependant on Claim 2, further recites "finding electric charges due to a disturbance," which is a concrete and practical result.

Claims 9-14, 17-20 and 26-29 recite a device in which there is a structural relationship in the functioning of a processor means and a storage means, and this structural relationship results in efficiencies of operation.

Claims 21 and 30-32 recite a method for producing a practical result, i.e. the strengths of energy sources.

Claim 31 recites a method for producing a practical result, i.e. information about electric currents excited (at least in part) by an electromagnetic field.

Claim 32 recites a method for producing a practical result, i.e. information about pressure disturbances excited (at least in part) by a pressure field.

Claims 22 and 33-35 describe several practical results. They describe a computing system with a structural relationship between a processing means and a storage means. They also describe a computing system that produces the strengths of physical disturbances. Furthermore, they describe compression which results in further efficiencies.

Claims 33, 34, and 35 which are dependant on Claim 22, each describe a specific practical result, of producing the strength of a pressure field, a particle flux, and an electric current respectively.

Claims 23-24 and 37-39 shows the practical result of using a computer to find the multiple interactions in a decomposition of interaction data. Furthermore, there is compression for some of the decomposition. This results in efficiencies and in a structural relationship between processing and storage.

Claims 37, 38, and 39 which are dependant on Claim 22, each describe a specific practical result, of producing the strength of a pressure field, an energy source, and an electric current respectively.

Response to Rejection of Claim 1 Under Obviousness-Type Double Patenting

The Examiner rejected Claim 1 under nonstatutory obviousness-type double patenting as being unpatentable over Claim 1 of copending Application No. 09/676,727 in view of Canning et al., Rockwell Inst. Sci. Center, "Fast Direct Solution of Standard Moment-Method Matrices," IEEE Antennas and Propagation Magazine, June 1998, pages 15-26.

Applicant assumes this is a provisional rejection since the claims are not in final form. Applicant will timely file a terminal disclaimer should the provisional rejection be sustained once agreement is reached on the claims.

Response to Rejection of Claims 1-4, 6-11, and 13-24 Under 35 U.S.C. 102(b)

The Examiner rejected Claims 1-4, 6-11, and 13-24 under 35 U.S.C. 102(b) as being anticipated by Canning et al., Rockwell Inst. Sci. Center, "Fast Direct Solution of Standard Moment-Method Matrices," IEEE Antennas and Propagation Magazine, June 1998, pages 15-26, hereinafter referred to as Rockwell.

Argument (4)

In Section 11-4 of the Office Action, the Examiner labels one of Applicant's arguments from his response of December 21, 2006 as (4):

(4) "Rockwell does not teach or make obvious that a second set of basis and a second set of weighting functions are to be obtained by separate rank reductions." (page 11, the last second paragraph, Amendment).

In Section 12-4 of the Office Action, the Examiner states: "Applicant's argument (4) is not persuasive.... Accordingly, Applicant admitted the matrix method used to find composite sources and composite testers can be a rank-revealing factorization such as...If one of ordinary skilled in the art cannot apply Rockwell's teaching to practice the claimed limitations of reducing matrix rank a potential enablement issue may be raised."

Applicant understands Examiner's response to mean that if Rockwell used a rank revealing factorization and Claim 1 recites reducing a rank, then the methods used must be the same. The Examiner's analysis does not address all limitations of the claimed method. As explained in Applicant's previous arguments: In Rockwell, the basis and testing functions are not

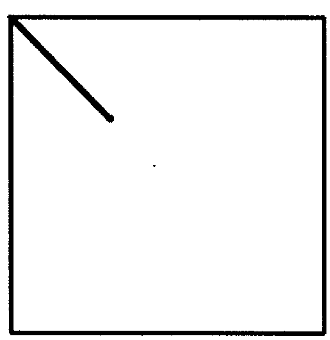
computed independently. In Rockwell, Equation (4) on Page 17 shows a method for compressing a sub-matrix **A**. Using **A**, a pair of interdependent basis functions and testing functions computed using a single rank reduction and these interdependent basis and testing functions were then used together to compress exactly **A**. These interdependent basis and testing functions were not computed from different rank reductions as recited in Claim 1. By contrast, Claim 1 recites computing composite sources using a first rank reduction and composite testers using a second rank reduction.

The difference between the interdependent basis and testing functions of Rockwell and the composite basis and testing functions of the present invention has several consequences. For example, when a block **A** is compressed by the method of Rockwell, it may then be written as

$$\mathbf{A} = \mathbf{U}\ \mathbf{D}\ \mathbf{V}^{h}$$

Here **D** is a diagonal matrix meaning that all non-diagonal elements of **D** are zero. Often, some of the diagonal elements are small and they may be approximated by zero. Thus, using Rockwell one may obtain a matrix **D** with the structure

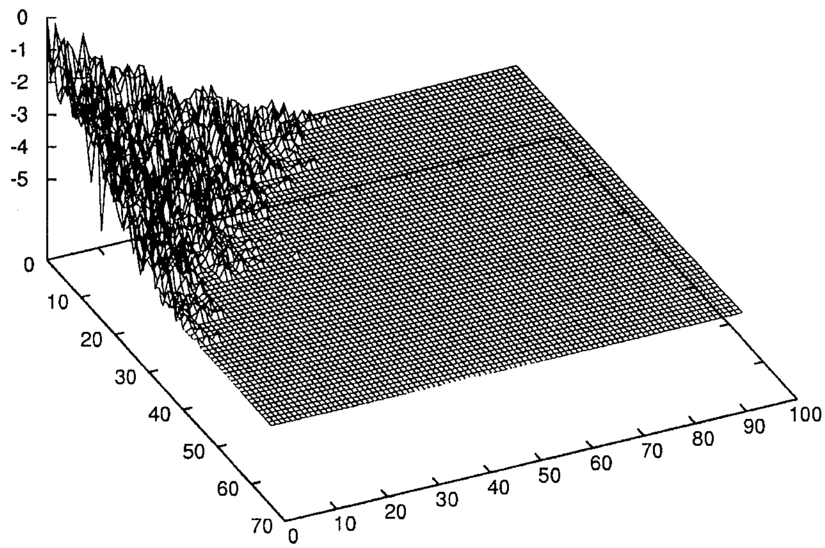
$D =$



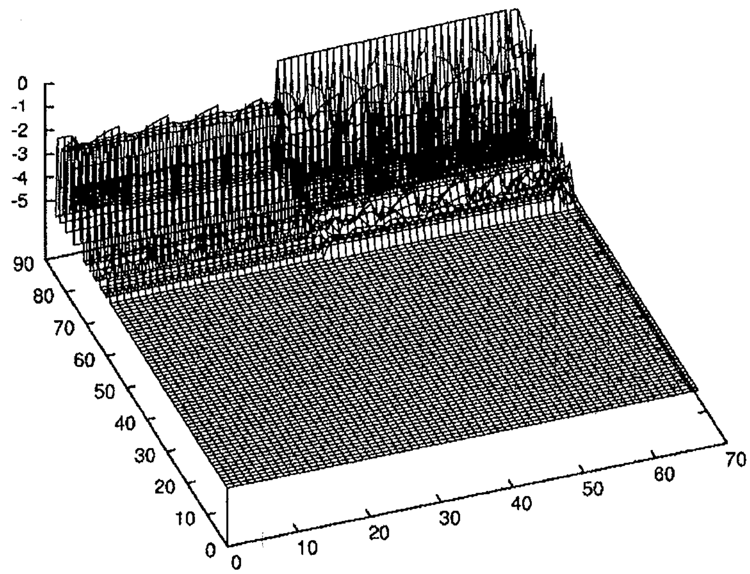
In contrast to Rockwell, the present application teaches embodiments that use certain data to produce composite sources and that uses certain data to produce composite testers, and it teaches that the composite testers may (in these embodiments) be produced independently from the composite sources. This allows embodiments where a block $\mathbf{Z}_{p,q}$ of an interaction matrix may be written (using notation from paragraphs [0129] and [0131] of the published application or the second and third paragraphs on Page 30 of the Application as filed) as

$$\mathbf{T}_{p,q} = \mathbf{d}_p^{\ L}\ \mathbf{Z}_{p,q}\ \ \mathbf{d}_q^{\ R}$$

An example of the structure one might find for $\mathbf{T}_{p,q}$ was shown in Figure 12 of the application:



In this example, $\mathbf{T}_{p,q}$ has a very different structure from the diagonal matrix of Rockwell. Prior art did not teach or make obvious that the separately created composite basis functions and composite testing functions would create a sparse $\mathbf{T}_{p,q}$. Prior art did not teach or make obvious that, as an option, computing composite basis functions and composite testing functions separately allows the possibility that the testing functions are changed but the basis functions are not (and vice versa), while compression is still achieved. Page 25 of the Application as filed (lines 24-28) stated, "The formula $\mathbf{V}^h\ \mathbf{A}^t = \mathbf{D}\ \mathbf{U}^h$ shows that $\mathbf{V}^h\ A^t$ will also have successive rows that tend to become smaller. The choices described above make obvious that successive rows of each block of the compressed matrix will also have that property." When composite testing functions are used without a significant change in the basis functions, and an example of the resulting $\mathbf{T}_{p,q}$ is

$T_{p,q} =$ 

Again, this is significantly different from the truncated diagonal matrix **D** of Rockwell shown above. In addition, the present invention teaches a number of advantages of the ability to independently create composite sources and / or composite testers. These advantages include improved sparseness and improved methods for computing a decomposition.

The present application also teaches other differences from Rockwell. In Rockwell, a block **A** of interaction data was compressed by a singular value decomposition of exactly **A**, which produced new basis and testing functions which had to be used together to describe exactly **A**. The present application teaches not only finding composite basis and testing functions separately. It also teaches methods for choosing/computing data other than A to be used in computing composite basis and/or testing functions. For example, it teaches how to use a relatively small amount data to produce composite sources or testers used to compress a relatively larger block of interaction data One such embodiment describes this in paragraphs [109] and [110] of the published application or in the last two paragraphs on Page 26 of the application as filed.

Regarding Claim 1, Rockwell does not teach or render obvious, separate rank reductions.

Regarding Claims 2 and 9, the present invention provides the ability to create a sparse matrix rather than merely a sparse representation of a matrix. In the present Office Action in 12-7 on page 18 the Examiner noted, "...a sparse representation of Z is obtained as disclosed by

Rockwell at page 16." Applicant notes that on page 16 of Rockwell, the expression "sparse representation" is used eight times, and the expressions "sparse manner", "sparse storage", and "sparse description" also occur. However, it is notable that this publication avoids saying that Z or related matrices were actually sparse. The sparse representation described by Rockwell may be illustrated by the figure below.

$U_{11}D_{11}V^h_{11}$	$U_{12}D_{12}V^h_{12}$	$U_{13}D_{13}V^h_{13}$	$U_{14}D_{14}V^h_{14}$	$U_{15}D_{15}V^h_{15}$
$U_{21}D_{21}V^h_{21}$	$U_{22}D_{22}V^h_{22}$	$U_{23}D_{23}V^h_{23}$	$U_{24}D_{24}V^h_{24}$	$U_{25}D_{25}V^h_{25}$
$U_{31}D_{31}V^h_{31}$	$U_{32}D_{32}V^h_{32}$	$U_{33}D_{33}V^h_{33}$	$U_{34}D_{34}V^h_{34}$	$U_{35}D_{35}V^h_{35}$
$U_{41}D_{41}V^h_{41}$	$U_{42}D_{42}V^h_{42}$	$U_{43}D_{43}V^h_{43}$	$U_{44}D_{44}V^h_{44}$	$U_{45}D_{45}V^h_{45}$
$U_{51}D_{51}V^h_{51}$	$U_{52}D_{52}V^h_{52}$	$U_{53}D_{53}V^h_{53}$	$U_{54}D_{54}V^h_{54}$	$U_{55}D_{55}V^h_{55}$

This figure shows a compressed form of a matrix Z, where each block is separately compressed. The compression method taught by Rockwell did not produce a sparse matrix to represent Z. Rather, it created a sparse representation of Z. Rockwell taught using an SVD on each Block (p,q) of Z, $Z_{p,q}$, and then replacing that block by a representation using $U_{p,q}$, $D_{p,q}$, and

$V_{p,q}$. When some of the diagonal elements of $D_{p,q}$, are approximated by zero, only some of the columns of $U_{p,q}$ and of $V_{p,q}$ are used, providing a compressed representation. This is also called a sparse representation of that block. In contrast to Rockwell, Claims 2 and 9 discuss zero elements in an interaction matrix and discuss a block-sparse matrix respectively.

The figure above highlights the distinction of separate rank reductions. Notice that in Rockwell $U_{p,q}$ and $V_{p,q}$ are created together from one SVD on a sub-matrix A and then they must be used together to produce a compressed representation of A. In contrast to this, in the present application (See Page 27, lines 18,19, or Paragraph [0112] of the Pubished Application) it states regarding one embodiment, "The matrix U will not be used, so one can save on computer operations by not actually calculating U."

Regarding Claim 21, the method of Rockwell created a decomposition in which the sparse representation of a block used composite basis functions from different rank reductions. On page 22 of Rockwell, second column, second to the last paragraph, it states:

> "Within **L** the 'u's are always identical to the 'u's in **Z**. However, the 'v's in **L** are different from the 'v's in **Z**, and must be calculated as shown above. Also, there are 'f' vectors necessary in **L** that do not occur in **Z**."

Equation (36) on Page 22 of Rockwell states:

$$A2 = u_2 \, v_2^h - u_1[3\text{-}4]f_2^h$$

This sparse representation of Block two of the decomposition uses u_2 from an SVD on Block two of **Z** and u_1 from an SVD on Block one of **Z** and uses f_2 which is calculated using Equations (32) and (36). In contrast, Claim 21 recites, "said second sub-matrices corresponding to composite sources produced by reducing a rank of a matrix of transmitted disturbances".

Regarding Claims 22 and 23, in Rockwell, the block **A** was used in an SVD only to compress exactly **A**. That is, the plurality of disturbances was the same as the data to be compressed. The present application teaches that data other than that in a block **A** may be used to compress block **A**.

Claim 22 recites, "and wherein said plurality of far-field disturbances contains disturbances that are not described by said interaction data."

Claim 23 recites, ".there are interactions in said portion that are not described by said plurality of disturbances"

Applicant asserts that Claims 1-4, 6-11, and 13-39 are directed to statutory subject matter and allowable over the prior art. Accordingly, Applicant respectfully requests allowance of Claims 1-4, 6-11, and 13-35.

<u>Response to Rejection of Claims 5 and 12 Under 35 U.S.C. 103(a)</u>

The Examiner rejected Claims 5 and 12 under 35 U.S.C. 103(a) as being unpatentable over Canning et al., Rockwell Inst. Sci. Center, "Fast Direct Solution of Standard Moment-

Method Matrices," IEEE Antennas and Propagation Magazine, June 1998, pages 15-26 in view of Applicant's assertion..

Regarding Claim 5, the cited prior art does not make obvious a method for factorization of an interaction matrix in Claim 2.

Regarding Claim 12, the cited prior art does not make obvious the use of LDM decomposition in connection with the other elements of Claim 9.

Applicant asserts that Claims 5 and 12 are directed to statutory subject matter and allowable over the prior art. Accordingly, Applicant respectfully requests allowance of Claims 5 and 12.

Summary

Applicant respectfully assert that Claims 1-39 are allowable over the prior art, and Applicant request allowance of Claims 1-39. If there are any remaining issues that can be resolved by a telephone conference, the Examiner is invited to call the undersigned attorney at (949) 721-6305 or at the number listed below.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: August 27, 2007

By:
Lee W. Henderson Ph.D.
Registration No. 41,830
Attorney of Record
Customer No. 20,995
(949) 760-0404

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